

What is claimed is:

1. A differential controlled delay unit, comprising:

a first amplifier having a first and a second transistor connected as a two-transistor positive amplifier, wherein a gate of the first transistor is connected to a drain of the second transistor and a gate of the second transistor is connected to a drain of the first transistor; and

5 a second amplifier having a third and a fourth transistor, a drain of the third and fourth transistors connected to a drain of the first and second transistors to form output terminals, wherein a differential input voltage is connected to gates of the second amplifier transistors, and a control input and power supply voltage is connected to drains of the first amplifier.

10 2. The delay unit of Claim 1, wherein the first amplifier transistors are PMOS transistors and the second amplifier transistors are NMOS transistors.

15 3. The delay unit of Claim 1, wherein a positive supply voltage is connected to the first amplifier and a negative supply voltage is connected to the second amplifier.

20 4. A differential controlled delay unit, comprising:

a first amplifier having a first and a second transistor connected as a two-transistor positive amplifier, wherein a gate of the first transistor is connected to a drain of the second transistor and a gate of the second transistor is connected to a drain of the first transistor; and

25 a second amplifier having a third and a fourth transistor, wherein a drain of the third and fourth transistors is connected to a drain of the first and second transistors to form output terminals, and a differential input voltage is connected to gates of the third and fourth transistors, and a control input and supply voltage is connected to the sources of the second amplifier.

5. The delay unit of Claim 4, wherein the first amplifier transistors are NMOS transistors and the second amplifier transistors are PMOS transistors.

5 6. The delay unit of Claim 4, wherein a positive supply voltage is connected to the second amplifier and a negative supply voltage is connected to the first amplifier.

10 7. A voltage controlled oscillator, comprising:

10 a first delay unit and a second delay unit, each further comprised of four transistors, said delay units each having a first amplifier having a first and a second transistor connected as a two-transistor positive amplifier, wherein a gate of the first transistor is connected to a drain of the second transistor and a gate of the second transistor is connected to a drain of the first transistor, said delay units each having a second amplifier having a third and a fourth transistor,

15 wherein a drain of the third and fourth transistors is connected to a drain of the first and second transistors, said connections forming output terminals of the delay unit, and

20 wherein output terminals of the first delay unit are connected to gates of the second amplifier of the second delay unit, and output terminals of the second delay unit are connected to gates of the second amplifier of the first delay unit, and wherein a control input and power supply voltage is connected to sources of the first amplifiers.

25 8. The voltage controlled oscillator of Claim 7, wherein the transistors for the first amplifiers are PMOS transistors and the transistors for the second amplifiers are NMOS transistors.

9. The voltage controlled oscillator of Claim 7, wherein a positive supply voltage is connected to the first amplifiers and a negative supply voltage or ground is connected to the second amplifiers.

5 10. The voltage controlled oscillator of Claim 7, further comprising an additional delay unit, wherein output signals from the second delay unit are connected to gates of the additional delay unit, and output signals of the additional delay unit are connected to gates of the first delay unit.

10 11. The voltage controlled oscillator of Claim 7, wherein the transistors for the first amplifiers are PMOS and the transistors for the second amplifiers are NMOS and a drain of the first and second transistors is connected to a drain of the third and fourth transistors to form outputs of the delay units,

15 and wherein outputs of the first delay unit are connected to gates of the second delay unit, and outputs of the second delay unit are connected to gates of the first delay unit, and wherein a control input and power supply voltage is connected to sources of the second amplifiers.

20 12. The voltage controlled oscillator of Claim 11, further comprising an additional delay unit, wherein outputs from the second delay unit are connected to gates of the additional delay unit, and outputs of the additional delay unit are connected to gates of the first delay unit.

25 13. The voltage controlled oscillator of Claim 7, wherein in the first delay unit and the second delay unit, drains of the first amplifier are connected to drains of the second amplifier to form output terminals,

and wherein the output signals of the first delay unit are connected to gates of the second delay unit, and output signals of the second delay unit are

connected to gates of the first delay unit, and wherein a control input and power supply voltage is connected to sources of the first and second delay units.

5        14. The voltage controlled oscillator of Claim 13, further comprising an additional delay unit, wherein output signals from the second delay unit are connected to gates of the additional delay unit, and output signals of the additional delay unit are connected to gates of the first delay unit.

10        15. The voltage controlled oscillator of Claim 7, wherein in the first delay unit and in the second delay unit, drains of the first amplifier are connected to sources of the second amplifier, said connections forming output terminals,

15        and wherein output terminals of the first delay unit are connected to gates of the second delay unit, and output terminals of the second delay unit are connected to gates of the first delay unit.

20        16. The voltage controlled oscillator of Claim 15, further comprising an additional delay unit, wherein output signals from the second delay unit are connected to gates of the additional delay unit, and output signals of the additional delay unit are connected to gates of the first input unit.

25        17. The voltage controlled oscillator of Claim 15, wherein the transistors of the first amplifiers are PMOS and the transistors of the second amplifiers are NMOS.

25        18. The voltage controlled oscillator of Claim 7, further comprising a charge pump and a buffer, wherein a buffered output voltage of the charge pump is a supply voltage to the first amplifiers.

19. The voltage controlled oscillator of Claim 7, further comprising at least one additional delay unit, wherein output terminals of a delay unit are connected to gates of a next delay unit, and output terminals of a last delay unit are connected to the gates of the first delay unit.

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20. A phase-locked loop, comprising:  
a phase frequency detector;  
a charge pump and loop filter connected to the phase frequency detector;  
a voltage controlled oscillator having at least two delay units, each delay unit further comprising four transistors, and connected with a supply and control voltage from the charge pump; and  
a voltage divider connected between the oscillator and the phase frequency detector.

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21. The phase-locked loop of Claim 20, further comprising a buffer connected between the charge pump and the voltage controlled oscillator.

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22. A delay locked loop, comprising:  
a phase detector;  
a charge pump and loop filter connected with the phase detector;  
a buffer amplifier; and  
a voltage controlled delay line having at least two delay units, each delay unit further comprising four transistors, and connected with a supply and control voltage from the charge pump and buffer amplifier, the voltage control oscillator also connected with the phase detector.

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23. A phase accumulator circuit, comprising:

a phase frequency detector;

a charge pump and loop filter, connected with the phase frequency detector;

5 a buffer amplifier connected with the charge pump and loop filter;

a voltage controlled oscillator having at least two delay units, each delay unit further comprising four transistors, and connected with a supply and control voltage from the charge pump and buffer amplifier;

10 a phase accumulator, connected with the voltage controlled oscillator and receiving inputs from the oscillator;

a programmable control input, connected to the phase accumulator; and

at least one toggle flip/flop, connected to the phase accumulator and receiving inputs from the phase accumulator.

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